AD

CCL MEMORANDUM REPORT NO. 4

COATINGS FOR INFRARED SIGNATURE CONTROL OF HELICOPTERS

BY

J. J. MCLESKEY, III

SEPTEMBER 1972

PREPARED FOR: COMMANDING OFFICER
ARMY AIR MOBILITY R&D LABORATORY
FORT EUSTIS, VIRGINIA 23604

U.S. ARMY ABERDEEN
RESEARCH AND DEVELOPMENT CENTER, COATING AND CHEMICAL
LABORATORY, ABERDEEN PROVING GROUND, MARYLAND

U. S. ARMY
ABERDEEN RESEARCH & DEVELOPMENT CENTER
COATING & CHEMICAL LABORATORY
Aberdeen Proving Ground
Maryland

UNCLASSIFIED

CCL MEMORANDUM

REPORT NO. 4

COATINGS FOR INFRARED SIGNATURE CONTROL OF HELICOPTERS

B

J. J. MCLES JR, III

SEPTEMBER 19[illegible]

AMCMS CODE NO. 512E.11.A5203

DEPARTMENT OF THE ARMY
PROJECT NO. 1F166605AA5203

PREPARED FOR: Commanding Officer
Army Air Mobility R&D Laboratory
Fort Eustis, Virginia 23604

Distribution limited to U.S. Gov't. agencies only; Test and Evaluation; 15 [illegible]. Other requests for this document must be referred to

[redacted] U.S. ARMY ABERDEEN RESEARCH AND DEVELOPMENT CENTER, COATING AND CHEMICAL LABORATORY, ABERDEEN PROVING GROUND, MARYLAND

ABSTRACT

This report reviews the state-of-the art in coating design for control of the infrared signature of helicopters. Past work is summarized and current work identified. The feasibility of using low emittance coatings is discussed.

TABLE OF CONTENTS

I. INTRODUCTION

Because infrared (IR) seeking missiles can be used against helicopters in a hostile environment, the IR signature becomes one of the important factors determining survivability. The engine is the primary source of IR radiation. However, under certain circumstances, other sources can make important contributions to the IR signature. These secondary sources are often the metal surfaces of the aircraft painted with dark colored military coatings.

Since the utilization of low emittance coatings is a possible means of reducing the emitted IR radiation and the associated vulnerability to IR seeking missiles, a review of unclassified, classified and foreign literature was conducted to become cognizant of the state-of-the art in the technology of low emittance coatings. This work was carried out for the Eustis Directorate, Air Mobility Research and Development Laboratory (AMRDL).

II. DETAILS OF SURVEY

In discussion with AMRDL personnel at Fort Eustis, the following requirements were established to provide a basis for reviewing candidate coating materials and techniques:

1. Low emittance in the infrared spectral region.
2. Dark military color.
3. Adequate exterior durability.
4. Standard application procedures.
5. Reasonable cost.

References 1 thr 10 were reviewed. They identified classified work conducted in-house by the Naval Ship Research and Development Center, Annapolis, Maryland, by Honeywell Inc., Roseville, Minnesota, under Air Force contract, and unclassified in-house work at this laboratory on spectral properties of pigments. No other work directly reated to this task could be found.

Based on these identifications, visits were made to Wright Patterson Air Force Base and the Naval Ship Research and Development Center, as well as the nineteenth Infrared Information Symposium and an Army contractor, General Dynamics.

As expected, both the resin and pigments influence IR coatings design. Most resins are organic in nature. As such, they contain carbon hydrogen (C-H) bonds. These bonds strongly absorb infrared energy around 3.5 microns and convert it to heat which significantly

increases the emittance. Only fluorinated binders lack this strong infrared absorption. However, these materials have not as yet been successfully formulated into air-dry coatings.

It has also been recognized that pigment type, size, color and purity affect infrared absorption characteristics. For example, white pigments like titanium dioxide have low absorption, earth pigments like iron oxides medium absorption, and dark pigments like carbon black high absorption in the visible and near IR regions.

The design of low IR emissive military coatings requires high visible absorption and low IR absorption. A suitable pigment with these absorption characteristics has not been found. In the past (5) a satisfactory substitute for a dark, IR reflective pigment was devised using a combination of primary colors with high near IR reflectance. This combination was visually dark and sufficiently reflective in the near IR. A similar approach is approximate for the spectral region further in the IR.

The problem of developing a satisfactory dark military coating with specified IR characteristics is currently under investigation in an Air Force contract (6). References 3, 4 and 7 cover some previous work under another contract. Completed Navy work is summarized in a classified report (4).

III. DISCUSSION

Because sunlight may be an important source of reflected IR energy from helicopters, the design objective of a low emissive coating may not be appropriate since no coating can, by Kirchoff's law, be low in reflectance to minimize solar reflectance and simultaneously low in emission in the same spectral region.

It is recommended that no development of a low emittance coating for helicopters be undertaken until a detailed analysis is carried out to determine optimum coating requirements for minimum IR signature. Related developments in spectrally selective coatings carried out by the Army, Navy, Air Force and foreign countries should also continue to be monitored to remain abreast of this specialized area of coating technology.

IV. REFERENCES

1. J. W. Shirie, "A Study of the Secondary IR Sources on the UH-1 Helicopter", General Dynamics, Pomona Division, submitted to Eustis Directorate, USA AMRDL, 1971.

2. DDC Report Bibliography, Search Control No. 052267, Defense Documentation Center, Alexandria, Virginia, 1971.

3. R. N. Schmidt, "Infrared Diffuse Reflector Coating", Honeywell, Minneapolis, Minn., 1967, AD 809220L.

4. R. N. Schmidt, "infrared Diffuse Reflector Coating", Honeywell, Minneapolis, Minn., 1967, AD 812645L.

5. M. H. Sandler, "Development of An Olive Drab Solar Heat Reflecting and Low Visibility Enamel", Coating and Chemical Laboratory, APG, Md., 1965, AD 473571.

6. Henry Mar, "Development of Infrared Diffuse Reflection - IR Thermal Camouflage Coatings", Honeywell, Roseville Minnesota, Quarterly Technical Report No. 1, Contract AF 33615-71-C1212, March 1971.

7. R. N. Schmidt, "Infrared Diffuse Reflector Coating Part II, Candidate Materials", AFML-TR-67-337, AD 510246.

8. IRIA ANNOTATED BIBLIOGRAPHY OF INFRARED LITERATURE, Vol XV, No. 4 and previous volumes, University of Michigan, Ann Arbor, Michigan.

9. Proceedings of the Nineteenth Infrared Information Symposium, Naval Research Office, 1971.

10. M. Cohen and J. Doner, "Infrared Reflectance Spectra for Selected Paint Pigments", Coating and Chemical Laboratory, APG, Maryland 1971.